ALTITUDE PROFILE OF AEROSOLS ON MARS FROM MEASUREMENTS OF ITS THERMAL RADIATION ON LIMB. V.I.Moroz, D.V.Titov, *Space Research Institute of Russian Academy of Science, Moscow, 117810*, Yu.M.Gektin, M.K.Naraeva, A.S.Selivanov, *Russian Institute of Space Devices Engineering, Moscow, 111024, Russia.*

Measurements of the thermal (range 7 - 13 μm) radiation of Mars with the high space resolution (~2 km) were made by the TERMOSKAN experiment of the Phobos mission (1, 2). Some of results were published earlier but only the surface radiation was analyzed in details (2-4). However some part of these measurements was made near the limb of the planet. The atmosphere gives an important input here in the planetary thermal radiation. Beyond the limb the atmosphere is the only source. The task of this work is to estimate some characteristics of the atmosphere using brightness profiles of the thermal radiation near the limb (Fig.1). An appropriate model of the temperature profile T(h) is necessary for such an analysis. A set of T(h) models (nominal, maximal and minimal) was defined using various sources including MARSGRAM (5), Viking-1 lander data (6), its theoretical considerations (7) and boundary layers models (8). On the next step the possible input of the atmospheric gaseous emissions (wing of CO_2 15 μm band) was estimated. It was found that even for the maximal T(h) this input is no more than a few percents of the measured radiation beyond the limb. Consequently the aerosols are responsible for almost all measured emission. The analysis of the observed profile showed that these aerosols have two components: (1) exponential with the scale height about 10 km and (2) some layered structure (two layers with maxima about 23 and 33 km consisted probably of ice).

Two sorts of aerosols profiles models were builded: grey (all parameters are independent from wavelength) and selective (with some hypotheses about the chemical composition and size distribution of particles). Some of the results are shown on Fig. 1 and in Table 1. Montmorillonite, palagonite, basaltic glasses were tested in selective models for the exponential component. Results are only weakly depend on composition. "Classic" gamma-distribution with $\alpha = \gamma = 1$ by the effective radius 1.6 μm was used for dust (mineral) and also for ice particles. For the dust it was justified by analysis of results of the solar occultation spectrometry (9) and ISM experiment (10) of the Phobos mission. Selective models permit to estimate not only optical depth and scale heights but also mass-loading (5×10^{-5} g/cm^2 for dust and 1×10^{-5} g/cm^2 for high altitude ice layers) and number densities of particles (~2 cm for dust particles near surface).

Selective models admit also the transfer from IR to visible optical depth. It was estimated that the IR (11.25 μm) optical depth 0.06 corresponds to the visible 0.13. This value is in accordance with results of three others remote sensing experiments of the Phobos mission (9-11). However this is 3 times less than measured on Viking landers at the same season (12). Probably a global change of dust content in the Mars atmosphere happened on the time interval about 10 years.

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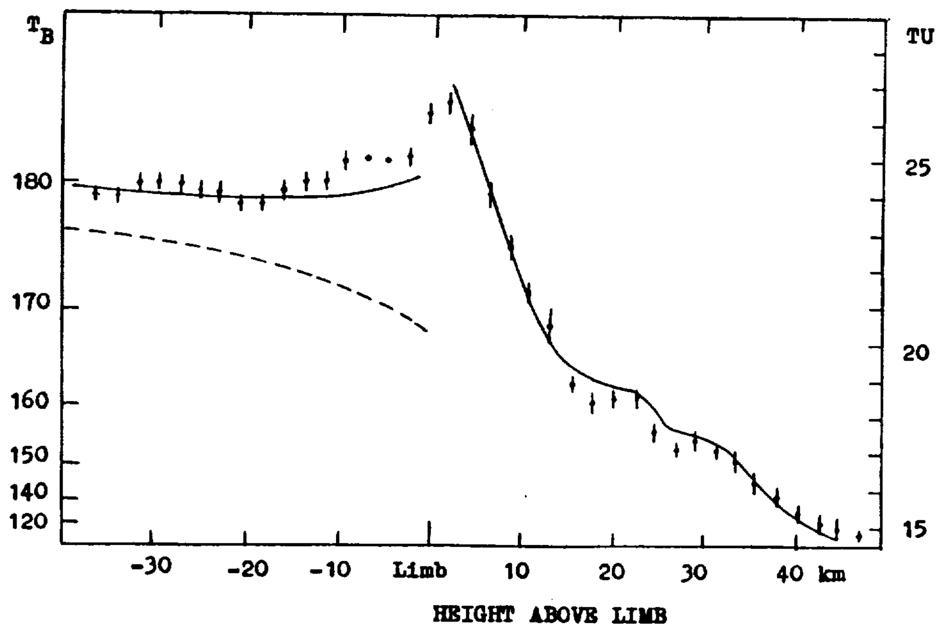

Fig. 1. Results of measurements on morning limb 26 March 1989.

Dots with error bars are measured brightness temperature profile along the limb normal to the limb. This is the average from 8 original profiles. Bars correspond to the r.m.s. errors. Full line is the selective model discribed briefly in the table below. The dashed line is the brightness temperature of the surface "cleaned" from the atmosphere. X-axis is the distance from the geometric limb along the profile. Y-axis on right shows telemetric units (the value 14.5 correspond to zero level of the brightness). The latitude of the observed place was 16°, longitude 148°, solar longitude L_S = 18°, local time 6^h 50^m.

Table 1. Parameters of models of height profile of aerosols.

	Grey	Selective
Single scattering albedo*	0.3	0.3 for dust 0.2 for ice
IR optical depth of exponential component**	$0.060^{+0.040}$	$0.055^{+0.025}$
Scale height	11^{+4}_{-3}	11^{+4}_{-3}
IR optical depth of layers:		
lower (23-24 km)	0.004	0.004
upper (33-34 km)	0.017	0.025

* Averaged (with weights) on the spectral range.

** Here and below for λ = 11.25 μm. Optical constants of palagonite were used by computations for exponential component and water ice for layers.